CHAPTER

CELLS AND TISSUES

MULTIPLE CHOICE QUESTIONS

1. **The first compound microscope was developed by:**
   (a) Robert Hooke (b) Leeuwenhoek (c) Zacharias Janssen (d) Aristotle
2. **A photograph taken through a microscope:**
   (a) Magnification (b) Resolution (c) Blurriness (d) Micrograph
3. **The increase in the apparent size of an object:**
   (a) Resolution (b) Micrograph (c) Magnification (d) None of these
4. **Resolution of human eye:**
   (a) 0.1 mm (b) 0.2 mm (c) 0.3 mm (d) 0.4 mm
5. **The magnification of a light microscope:**
   (a) 1000X (b) 1500X (c) 2000X (d) 2500X
6. **The magnification of an electron microscope:**
   (a) 100,000X (b) 150,000X (c) 200,000X (d) 250,000X
7. **Cells were first described by a British scientist:**
   (a) Robert Hooke (b) Leeuwenhoek (c) Schleiden (d) Schwann
8. **Who proposed that all living cells arise from pre-existing cells?**
   (a) Robert Brown (b) Rudolf Virchow (c) Louis Pasteur (d) Leeuwenhoek
9. **Who discovered nucleus in the cell?**
   (a) Aristotle (b) Robert Brown (c) Schwann (d) Schleiden
10. **The cell wall of fungi is made up of:**
    (a) Cellulose (b) Lignin (c) Peptidoglycan (d) Chitin
11. **The cell wall of prokaryotes is made up of:**
    (a) Cellulose (b) Lignin (c) Peptidoglycan (d) Chitin
12. **Microtubules are made up of:**
    (a) Tubulin (b) Tropomyosin (c) Myosin (d) Actin
13. **Microfilaments are made up of:**
    (a) Tubulin (b) Tropomyosin (c) Myosin (d) Actin
14. **Which organelles are involved in protein syntyhesis?**
    (a) Mitochondria (b) Lysosomes (c) Ribosomes (d) Nucleus
15. **Which organelles are involved in energy production?**
    (a) Mitochondria (b) Lysosomes (c) Ribosomes (d) Nucleus
16. **The type of plastids that contain pigments associated with bright colours:**
    (a) Chloroplasts (b) Chromoplasts (c) Leucoplasts (d) All of these
17. **Golgi was awarded Nobel Prize in:**
    (a) 1905 (b) 1906 (c) 1907 (d) 1908

18. De Duve was awarded Nobel Prize in:
(a) 1972 (b) 1973 (c) 1974 (d) 1975
19. The cells that undergo contraction and share their role in movements in body:
(a) Nerve (b) Muscle (c) Skin (d) Bone
20. The solution that has relatively more solute:
(a) Hypertonic (b) Hypotonic (c) Isotonic (d) None of these
21. The shrinking of cytoplasm is:
(a) Endocytosis (b) Exocytosis (c) Diffusion (d) Plasmolysis
22. Which term refers to the relative concentration of solutes in the solution:
(a) Diffusion (b) Osmosis (c) Tonicity (d) Turgor
23. Energy is required in:
(a) Osmosis (b) Diffusion (c) Filtration (d) Active transport
24. Which one is not an animal tissue?
(a) Epithelial (b) Connective (c) Epidermal (d) Nervous
25. The muscles found in heart:
(a) Skeletal (b) Smooth (c) Cardiac (d) None of these
26. The tissues located at the tips of roots and shoots:
(a) Apical meristem (b) Lateral meristem (c) Cambium (d) None of these
27. The epidermal tissues contain:
(a) Root hairs (b) Stomata (c) Both a & b (d) None of these
28. Ground tissues are made up of:
(a) Collenchyma (b) Sclerenchyma (c) Parenchyma (d) Tracheids
29. The tissues present in the midrib of the leaves and in petals of flowers:
(a) Collenchyma (b) Sclerenchyma (c) Both a & b (d) None of these
30. Tracheids are present in:
(a) Xylem (b) Phloem (c) Epidermal tissue (d) Parenchyma
31. A plant tissue composed of more than one type of cells:
(a) Compound (b) Support (c) Meristematic (d) Ground
32. The cell walls of sclerenchyma tissues are hardened with:
(a) Chitin (b) Cellulose (c) Peptidoglycan (d) Lignin
33. Companion cells are present in:
(a) Xylem (b) Phloem (c) Epidermal tissues (d) None of these

ANSWERS:

1	c	2	d	3	c	4	a	5	b
6	d	7	a	8	b	9	b	10	d
11	c	12	a	13	d	14	c	15	a
16	b	17	b	18	c	19	b	20	a
21	d	22	c	23	d	24	c	25	c
26	a	27	c	28	c	29	a	30	a
31	a	32	d	33	b				

SHORT QUESTIONS

Q. No. 1 What is a microscope?

MICROSCOPE

A microscope is an instrument which magnifies the images of tiny objects so they become easily visible to human eye.

Q. No. 2 Define microscopy.

MICROSCOPY

The use of microscope is known as Microscopy.

Q. No. 3 Who first invented the compound microscope?

INVENTION OF COMPOUND MICROSCOPE

The first compound microscope was developed by Zacharias Janssen, in Holland in 1595. It was simply a tube with lenses at each end and its magnification ranged from 3X to 9X.

Q. No. 4 Define magnification.

Magnification

The increase in apparent size of an object is called magnification.

- It is an important factor in microscopy.

Q. No. 5 Define resolution or resolving power.

RESOLUTION OR RESOLVING POWER

The minimum distance at which two objects can be seen as separate objects is called resolution or resolving power.

- It is the measure of the clarity of an image.

Q. No. 6 What is the resolution of human eye?

RESOLUTION OF HUMAN EYE

Human eye can differentiate between two points which are at least 0.1 mm apart. This is known as the resolution of human eye. If we place two objects 0.05 mm apart, human eye would not be able to differentiate them as two separate objects.

Q. No. 7 How magnification and resolution can be increased?

INCREASE IN MAGNIFICATION AND RESOLUTION

The magnification and resolution can be increased with the help of lenses.

Q. No. 8 Define Micrograph.

MICROGRAPH

A photograph taken through a microscope is called a micrograph.

Q. No. 9 What do you mean by LM 109X?

It tells us that the photomicrograph was taken through a light microscope and the image has been magnified 109 times.

Q. No. 10 Write postulates of cell theory.

POSTULATES OF CELL THEORY

Cell theory in its modern form, includes the following principles,

- All organisms are composed of one or more cells.
- Cells are the smallest living things, the basic unit of organization of all organisms.
- Cells arise only by divisions in previously existing cells.

Q. No. 11 Explain why is it not enough to just say that a solution is hypertonic?

Hypertonic and hypotonic are relative terms. So one must say what the solution is compared to.

Q. No. 12 What is the difference between Cell Membrane and Plasma Membrane?

DIFFERENCE BETWEEN CELL MEMBRANE AND PLASMA MEMBRANE

When we talk about all the membranes of a cell, we call them as cell membranes. When we talk about only the outer membrane of the cell, we refer to it as Plasma membrane.

Q. No. 13 In diffusion & filtration, only small molecules can pass across membrane. Which process would move the molecules faster?

Filtration, as it is aided by hydrostatic pressure.

Q. No. 14 Why colony of cells is not a tissue?

In a colony of cells, there are many cells & each cell performs all general functions on its own. Such a group does not get tissue level of organization because cells are not specific & there is no coordination between them.

Q. No. 15 Birds fly by flapping their wings. What do you think is the type of muscle responsible for wings' flapping?

Skeletal Muscles

LONG QUESTIONS

Q. No. 1 Write a note on light microscope.

LIGHT MISCROSCOPE

Principle:

A light microscope works by passing visible light through a specimen.

Construction:

It consists of two glass lenses.

Working:

One lens produces an enlarged image of the specimen and the second lens magnifies the image and projects it into the viewer's eye or onto photographic film.

Micrograph:

A photograph taken through a microscope is called a micrograph.

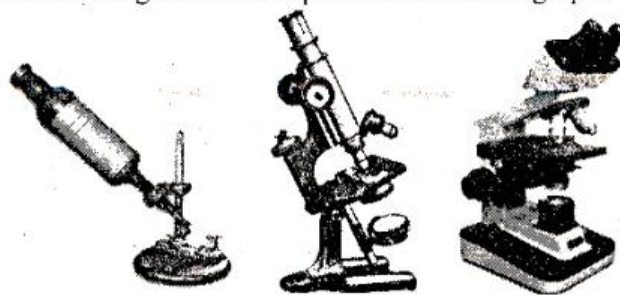



Figure: Light Microscopes: From earlier (left) to the latest (right)

Magnification:

A light microscope can magnify objects only 1500 times without causing blurriness. Its magnification is 1500X.

Resolution:

Resolution of a light microscope is 0.2 micrometer (µm).

(1 µm = 1/1000 mm)

Light microscope can not resolve objects smaller than 0.2 µm. It is about the size of the smallest bacterium.

Limitation in Bacterium Image:

The image of a bacterium can be magnified many times, but light microscope cannot show the details of its internal structure.

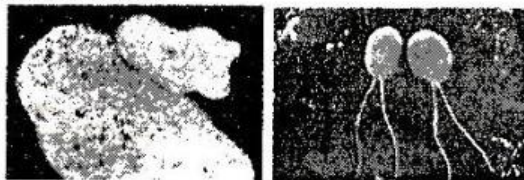



Figure: Light Microscopes view; Amoebae (left), Unicellular algae (right)

Q. No. 2 Write a note on electron microscope.

ELECTRON MISCROSCOPE

Introduction:

It is the most advanced form of microscope.

Working:

In electron microscope, the object and the lens are placed in a vacuum chamber and a beam of electrons is passed through the object. Electrons pass through or are reflected from object and make image. Electromagnetic lenses enlarge and focus the image onto a screen or a photographic film.

Resolution:

Electron microscope has much higher resolving power than light microscope. The most modern EM can distinguish objects as small as 0.2 nanometer.

1 nm=1/1000,000 mm.

It is a thousand-fold improvement over the LM.

Magnification:

EM can magnify objects about 250,000 times.

Detection in Special Conditions:

Under special conditions, EM can detect individual atoms. Cells, organelles, and even molecules like DNA and protein are much larger than single atoms.

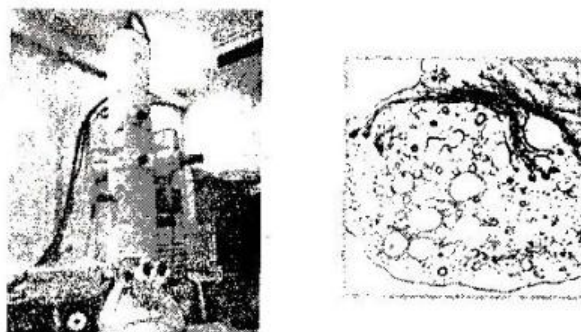



Figure: TEM (left) and view of an animal cell (right) through it

Types of Electron Microscope:

There are two types of electron microscope:

i. Transmission Electron Microscope (TEM)
ii. Scanning Electron Microscope (SEM)

i. **Transmission Electron Microscope:**

Working: In TEM, electrons are transmitted through the specimen.

Usage: TEM is used to study the internal cell structure.

ii. **Scanning Electron Microscope:**

Working: In SEM, electrons are reflected from the metal coated surfaces.

Usage: SEM is used to study the structure of cell surfaces.

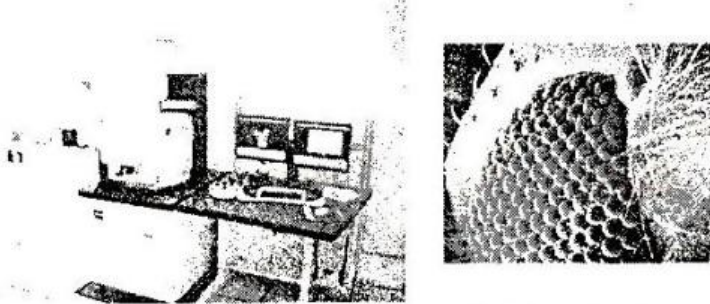



Figure: SEM (left) and view of mosquito's head and eye (right) through it

Q. No. 3 Describe the history of formulation of cell theory.

HISTORY OF THE FORMULATION OF CELL THEORY

Role of Aristotle:

Aristotle presented the idea that all animals and plants are somehow related.

Role of Robert Hooke:

Cells were first described by a British scientist, Robert Hooke in 1665. He used his self-made light microscope to examine a thin slice of cork. Hooke observed a 'honeycomb' of tiny empty compartments. He called those compartments in the cork as 'cellulae'. His term has come to us as cells.

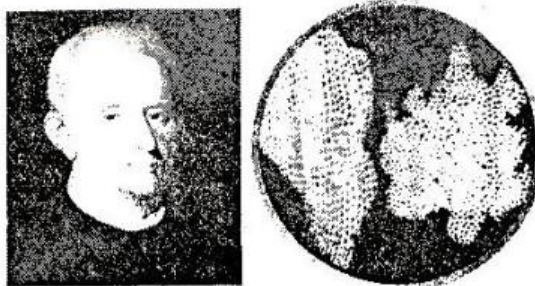



Figure: Robert Hooke was a Chemist, Mathematician and Physicist

Role of Leeuwenhoek:

The first living cells were observed a few years later by Dutch naturalist Antonie van Leeuwenhoek. He observed tiny organisms from pond water under his microscope and called them 'animalcules'.

Role of Jean Baptist de-Lamarck:

In 1809, Jean Baptist de-Lamarck proposed that:

'No body can have life if its parts are not cellular tissues or are not formed by cellular tissues'.

Role of Robert Brown:

In 1831, a British botanist Robert Brown discovered nucleus in the cell.

Role of Matthias Schleiden:

In 1838, a German botanist Matthias Schleiden studied plant tissues and made the first statement of Cell Theory. He stated that:

'All plants are aggregates of individual cells which are fully independent'.

Role of Theodor Schwann:

One year later, in 1839, a German zoologist Theodor Schwann reported that all animal tissues are also composed of individual cells.

Role of Rudolf Virchow:

In 1855, Rudolf Virchow, a German physician, proposed an important extension of cell theory. He proposed that, 'all living cells arise from pre-existing cells (Omnis cellula e cellula).

Role of Louis Pasteur:

In 1862, Louis Pasteur provided experimental proof of Virchow's idea.

Postulates of Cell Theory:

Cell theory in its modern form, includes the following principles,

- All organisms are composed of one or more cells.
- Cells are the smallest living things, the basic unit of organization of all organisms.
- Cells arise only by divisions in previously existing cells.

Figure: Three great German biologists

Q. No. 4 Write a note on sub-cellular or acellular particles.

SUB-CELLULAR OR ACELLULAR PARTICLES

According to the first statement of cell theory, all organisms are composed of one or more cells. The following organisms are sub-cellular or acellular particles and are not composed of cells:

- Viruses
- Prions
- Viroids

Non-living Characteristic:

They do not run any metabolism inside them.

Living Characteristics:

They show some characteristics of living organisms like:

- They can increase in number.
- They can transmit their characters to the next generations.

Classification:

Such acellular particles are not classified in any of the five kingdoms of organisms.

Q. No. 5 **Write a note on cell wall.**

CELL WALL

Presence: It is found in plants, plant-like protists, and fungi. It is absent in animals and many animal-like protists.

Introduction: Cell wall is a non-living and strong component of cell.

Location: It is located outside plasma membrane.

Functions: Cell wall provides:

- Shape
- Strength
- Protection
- Support

Types of Cell Wall:

i. **Primary Wall:**
The outer layer of plant cell wall is known as the primary wall. Cellulose is the most common chemical in it.

ii. **Secondary Wall:**
Some plant cells, have secondary walls on the inner side of primary wall. It is much thicker and contains lignin and some other chemicals. Example: Xylem cells.

Plasmodesmata:

There are pores in the cell walls of adjacent cells, through which their cytoplasm is connected. These pores are called plasmodesmata.

Chemical Composition of Cell wall:

Fungi: The cell wall of fungi is made up of chitin.

Prokaryotes:
In prokaryotes, the cell wall is composed of peptidoglycan that is a complex of amino acids and sugars.

Plants: The cell wall of plants is composed of cellulose.

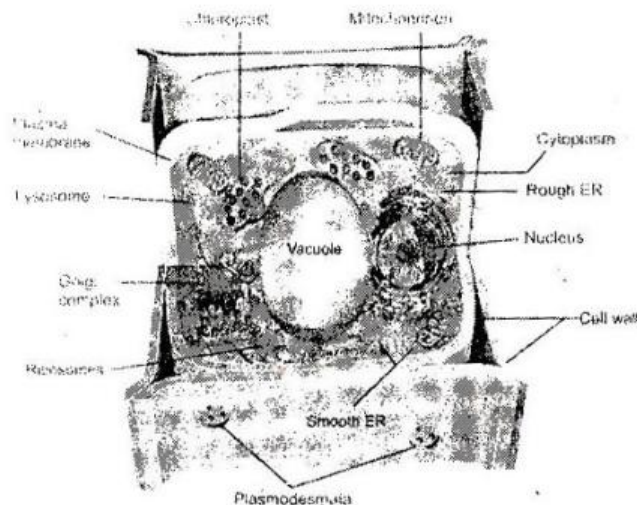



Figure: The Ultra-Structure of a plant cell

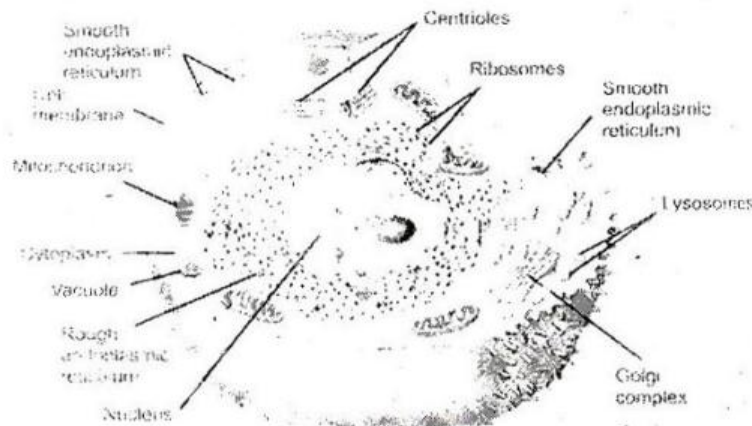



Figure: The Ultra-Structure of a an Animal cell

Q. No. 6 **Write a note on cell membrane.**

CELL MEMBRANE

Introduction:

All prokaryotic and eukaryotic cells have a thin and elastic cell membrane covering the cytoplasm.

Location:

It is the outer most boundary of animal cell and in plants, it is present inside the cell wall.

Functions:

i. Semi-permeable Barrier:

Cell membrane functions as a semi-permeable barrier, allowing a very few molecules across it while fencing a majority of chemicals inside the cell. In this way, it maintains internal composition of cell.

ii. Chemical sensor:

Cell membrane also senses chemical messages and can identify other cells.

Chemical Composition:

Chemical analysis reveals that cell membrane is mainly composed of the following:

- Proteins
- Lipids
- Carbohydrates (small amounts)

Structure:

Electron microscopic examinations of cell membranes have led to the development of a Fluid Mosaic Model of cell membrane.

Fluid-Mosaic Model:

According to this model:

- There is a lipid bi-layer in which proteins are embedded.
- The lipid bi-layer gives fluidity and elasticity to the membrane.
- Small amounts of carbohydrates are also found in cell membranes. These are joined with proteins or lipids of the membrane.
- In eukaryotic cells, cholesterol is present in the lipid bi-layer.

Membrane-Bounded Organelles:

In eukaryotic cells many organelles are bounded by cell membranes:

- Mitochondria
- Chloroplasts
- Golgi apparatus
- Endoplasmic reticulum

Difference between Cell Membrane and Plasma Membrane:

When we talk about all the membranes of a cell, we call them as cell membranes. When we talk about only the outer membrane of the cell, we refer to it as Plasma membrane.

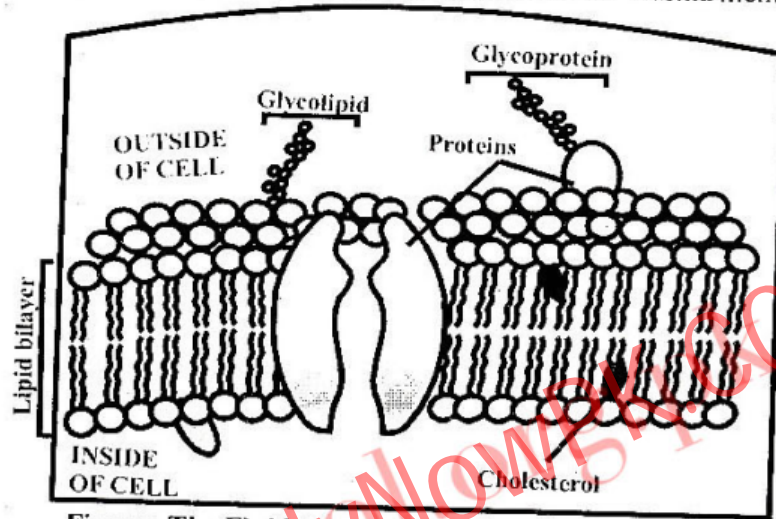



Figure: The Fluid-Mosaic Model of Cell Membrane

Q. No. 7 Write a note on cytoplasm.

CYTOPLASM

Introduction:

Cytoplasm is the semi-viscous and semi-transparent substance.

Location:

It is present between plasma membrane (cell membrane) and the nuclear envelope.

Chemical Composition:

It contains:

- Water
- Many organic molecules (proteins, carbohydrates, lipids)
- Inorganic salts

Function:

Cytoplasm has the following important functions:

- It provides space for the proper functioning of the organelles.
- It is a site for many biochemical (metabolic) reactions e.g., Glycolysis (breakdown of glucose during cellular respiration) occurs in cytoplasm.

Q. No. 8 Write a note on cytoskeleton.

CYTOSKELETON

Introduction:

Cytoskeleton is a network of microfilaments and microtubules.

Microtubules:

Composition: Microtubules are made up of tubulin protein.

Function:

- These help cells to hold their shape.
- They are the major components of cilia and flagella.

Microfilaments:

Composition: Microfilaments are thinner and are made up of action protein.

Function:

- They help cells to change their shapes.

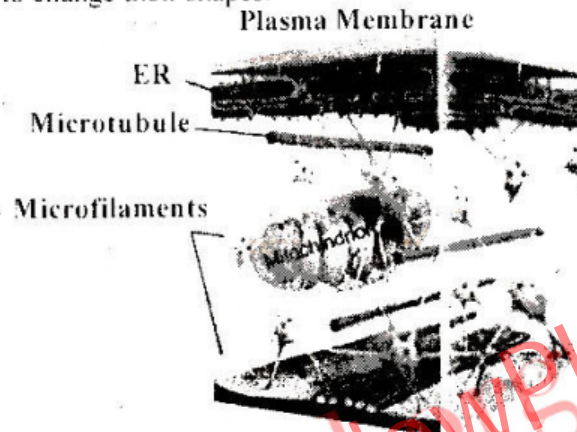



Figure: Cytoskeleton

Q. No. 9 Write a note on nucleus.

NUCLEUS

Presence:

A prominent nucleus occurs in eukaryotic cells.

Location:

- In animal cells, it is located in the center.
- In mature plant cells, due to the formation of a large central vacuole, it is pushed to the side.

Nuclear Envelope:

Nucleus is bounded by a double membrane known as Nuclear Envelope. Nuclear envelope contains many small pores that enable it to act as a semi permeable membrane.

Nucleoplasm:

Inside the nuclear envelope, a granular fluid, nucleoplasm is present. Nucleoplasm contains one or two nucleoli (singular: nucleolus) and chromosomes.

Nucleolus:

Nucleolus is a dark spot and it is the site where ribosomal RNA are formed and assembled as ribosomes.

Chromatin:

Chromosomes are visible only during cell-division. During interphase, (non-dividing phase), they are in the form of fine thread-like structures called chromatin.

Chromosomes:

Chromosomes are composed of Deoxyribonucleic acid (DNA) and proteins.

Prokaryotic Cells:

The prokaryotic cells do not contain prominent nucleus. Their chromosome is made up of DNA only and is submerged in the cytoplasm.

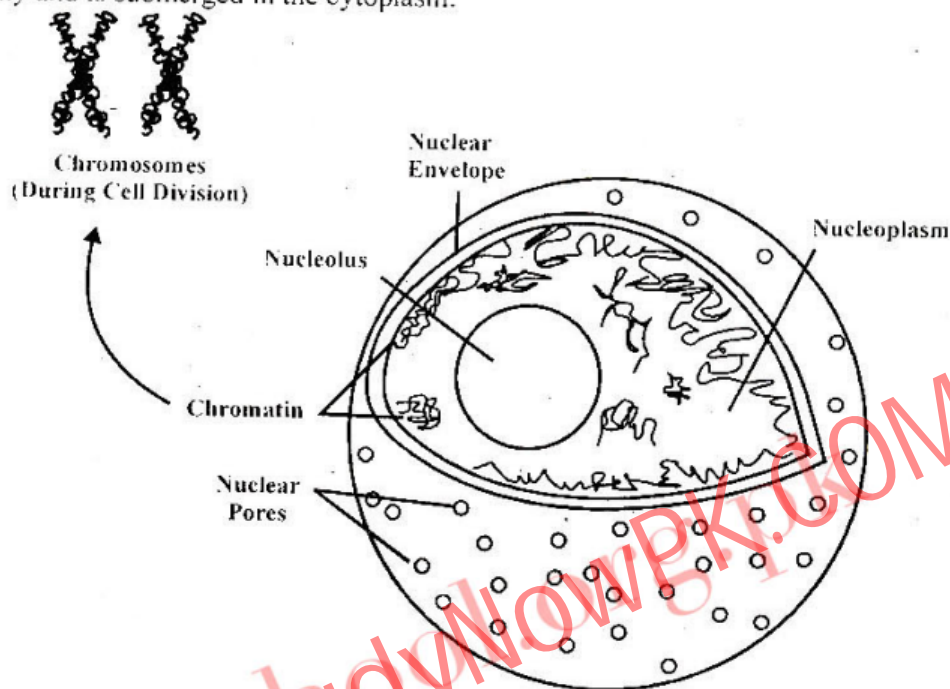



Figure: Structure of Nucleus

Q. No. 10 Write a note on ribosomes.

RIBOSOMES

Introduction:

Ribosomes are tiny granular structures.

Location:

They are either freely floating in the cytoplasm or are bound to endoplasmic reticulum (ER).

Chemical Composition:

Each ribosome is made up of equal amounts of:

- Proteins
- Ribosomal RNA (rRNA)

Non-membranous:

Ribosomes are not bound by membranes and are so found in prokaryotes.

Size:

Eukaryotic ribosomes are larger than prokaryotic ribosomes.

Structure:

Ribosomes are composed of a larger sub-unit and a smaller sub-unit. When a ribosome is not working, it disassembles into its sub-units.

Function:

Ribosomes are the sites of protein synthesis. Protein synthesis is extremely important to cells, and so large numbers of ribosomes are found throughout cells.

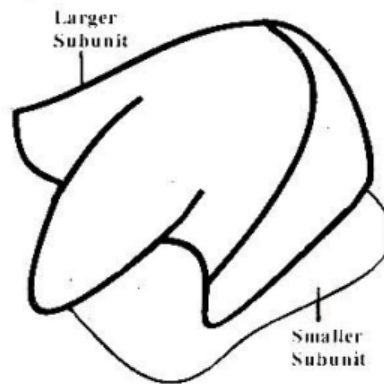



Figure: Ribosome

Q. No. 11 Write a note on mitochondria.

MITOCHONDRIA

Presence: Mitochondria are found in eukaryotic cells only.
Singular: The singular of mitochondria is mitochondrion.
Structure:

- Mitochondria are double-membranous organelles.
- The outer membrane is smooth.
- The inner membrane forms many infoldings called cristae (singular: crista). This serves to increase the surface area on which membrane-bound reactions can take place.
- There is an inner mitochondrial matrix.

Semi Autonomous Organelle:

Mitochondria have their own DNA and Ribosomes. The ribosomes of mitochondria are more similar to bacterial ribosomes than to eukaryotic ribosomes.

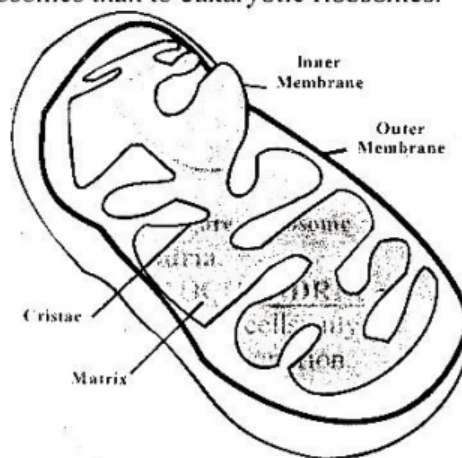



Figure: Mitochondrion

Functions:

- Mitochondria are the sites of aerobic respiration.
- They are major energy production centers.

Q. No. 12 Write a note on plastids.

PLASTIDS

Introduction: Plastids are membrane-bound organelles.

Presence: Plastids only occur in the cells of plants and photosynthetic protists (algae).

Types: Plastids are of three types:

i. Chloroplasts
ii. Chromoplasts
iii. Leucoplasts

i. Chloroplasts:

Structure: Chloroplast is also bounded by a double membrane. The outer membrane is smooth.

Thylakoids:

The inner membrane gives rise to sacs called 'Thylakoids'. The thylakoids contain chlorophyll (the green pigment necessary for photosynthesis) and associated pigments.

Granum: The stack of thylakoids is called 'Granum'. (Plural: grana)

Stroma: The grana float in the inner fluid of chloroplast, which is called 'Stroma'.

Function: Chloroplasts are the sites of Photosynthesis in eukaryotes, since chlorophyll is present in thylakoids.

ii. Chromoplasts:

Introduction: The second type of plastids in plant cells are chromoplasts.

Composition: They contain pigments associated with bright colors.

Occurrence: They are present in the cells of flower petals and fruits.

Function

- Their function is to give colors to petals and fruits.
- Thus they help in pollination and dispersal of fruit.

iii. Leucoplasts:

Introduction:

Leucoplasts are the third type of plastids.

Colour: They are colourless.

Occurrence: Thus they are present in those parts of plants which store food.

Function:

- They store starch, proteins and lipids.

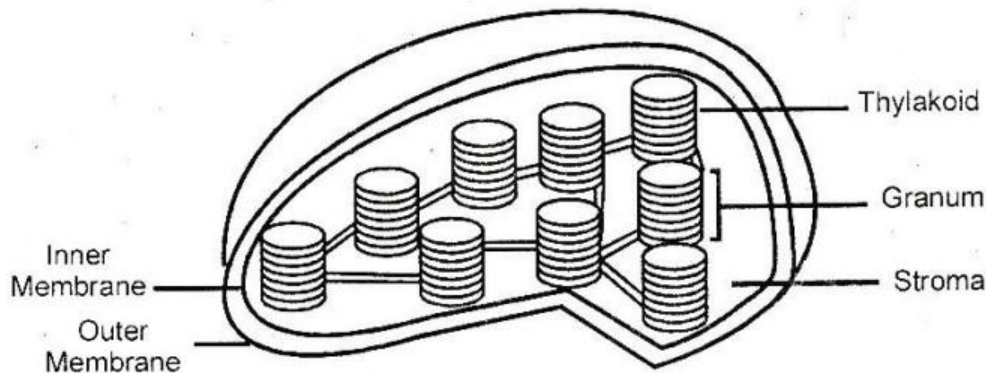



Figure: Chloroplast

Q. No. 13 Write a note on endoplasmic reticulum.

ENDOPLASMIC RETICULUM

Introduction:

Endoplasmic Reticulum is a network of inter-connected channels.

Location:

It extends from cell membrane to nuclear envelope.

Types of Endoplasmic Reticulum:

The network exists in two forms:

i. Rough Endoplasmic Reticulum
ii. Smooth Endoplasmic Reticulum

i. Rough Endoplasmic Reticulum (RER):

It is named so because of rough appearance due to numerous ribosomes attached to it.

Function:

Due to the presence of ribosomes. RER serves a function in protein synthesis.

ii. Smooth Endoplasmic Reticulum (SER):

SER lacks ribosomes.

Functions:

It is involved in:

- Lipid metabolism
- Transport of materials across the cell
- Detoxification of harmful chemicals that have entered the cell.

Figure: Smooth and rough Endoplasmic Reticulum

Q. No. 14 Write a note on Golgi Apparatus.

GOLGI APPARATUS

Discovery:

An Italian physician, Camillo Golgi discovered these organelles and thus they were named after him. In 1906, Golgi was awarded Nobel Prize for physiology & medicine.

Presence: Golgi apparatus occurs both in animal and plant cells.

Structure:

Golgi apparatus is a set of flattened sacs called 'Cisternae'. In this set, many cisternae are stacked over each other, and the complete set is called Golgi apparatus or Golgi complex.

Functions

- It modifies molecules coming from rough endoplasmic reticulu .
- It packs those molecules into small membrane bound sacs called 'Golgi vesicles'.

Transport of Golgi Vesicles:

These sacs can be transported to various location within the cell or to its exterior, in the form of secretions.

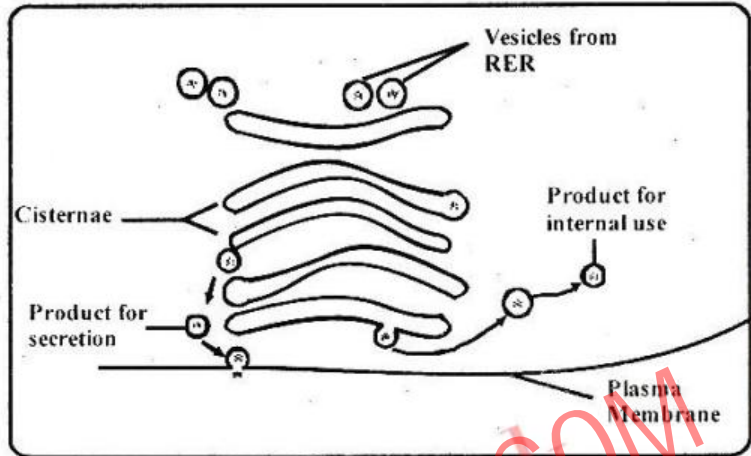



Figure: Functioning of the Golgi Apparatus

Q. No. 15 Write a note on lysosomes.

LYSOSOMES

Discovery:

In the mid-twentieth century, a Belgian scientist Christian Rene de Duve discovered lysosomes. De Duve won the 1974 Nobel Prize for physiology & medicine.

Structure: Lysosomes are single-membrane bound organelles.

Function:

They contain strong digestive enzymes and work for the break down (digestion) of food and waste materials within the cell.

Mechanism:

During its function, a lysosome fuses with the vacuole that contains the targeted material and its enzymes break down the material.

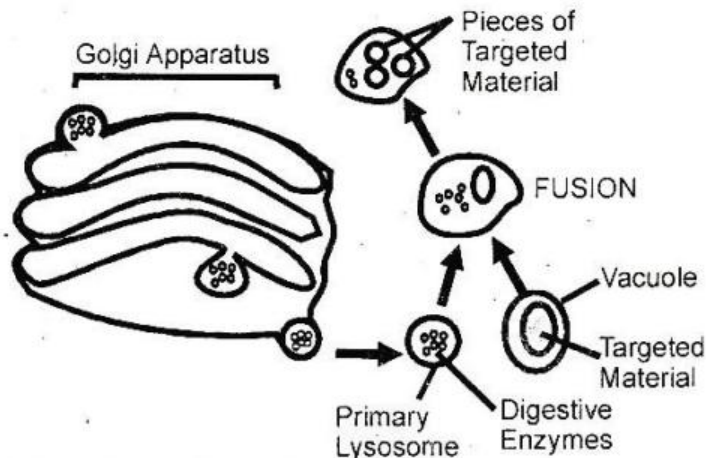



Figure: Formation and Function of Lysosome

Q. No. 16 Write a note on centrioles.

CENTRIOLES

Introduction:

Centrioles are present in animals and many unicellular organisms.

Number:

Centrioles are usually two in number.

Location:

They are located near the exterior surface of the nucleus.

Centrosome:

The two centrioles are collectively called a 'Centrosome'.

Structure:

- Centrioles are hollow and cylindrical organelles.
- Each centriole is made up of nine triplets of microtubules.
- They are made up of tubulin protein.

Function:

- Their function is to help in the formation of spindle-fibers during cell division.
- In some cells, they are also involved in the formation of cilia and flagella.

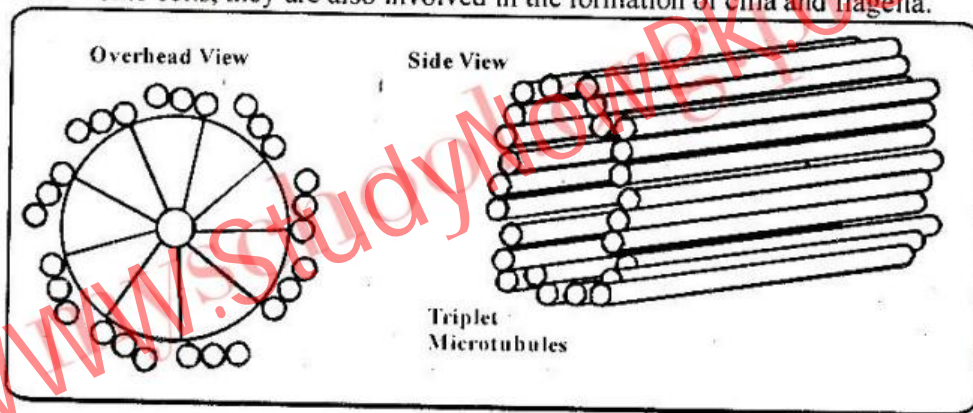



Figure: A Centriole

Q. No. 17 Write a note on vacuoles.

VACUOLES

Introduction:

Vacoules are fluid-filled single-membranous organelles. Cells have many small vacuoles in their cytoplasm.

In Plant Cells:

When a plant cell matures, its small vacuoles absorb water and fuse to form a single large vacuole in center. The cell in this state becomes turgid.

In Animal Cells:

Food Vacuole:

Many cells take in materials from outside in the form of food vacuole and then digest the material with the help of lysosomes.

Contractile Vacuole:

Some unicellular organisms use contractile vacuole for the elimination of wastes from their bodies.

Q. No. 18 Differentiate between Eukaryotic and Prokaryotic Cells

DIFFERENCE BETWEEN EUKARYOTIC AND PROKARYOTIC CELLS

Prokaryotes possess prokaryotic cells which are much simpler than eukaryotic cells. The main differences between the two are as follows:

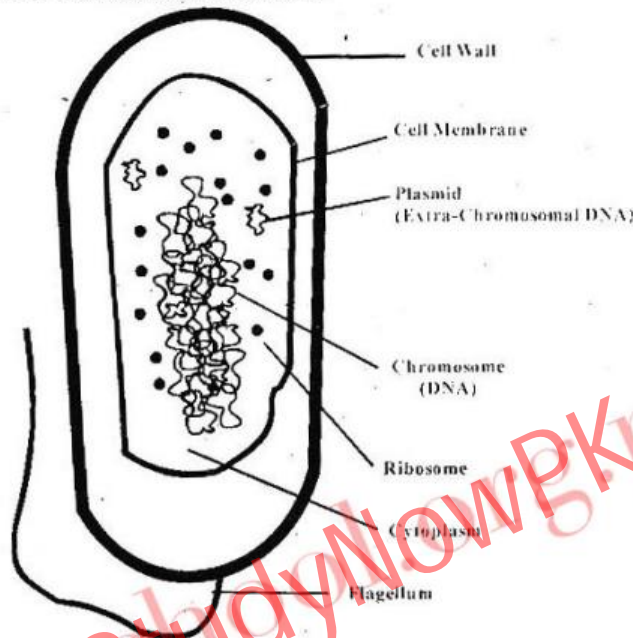



Figure: A General Prokaryotic Cell

EUKARYOTIC CELL	PROKARYOTIC CELL
Nucleus Eukaryotic cells have prominent nucleus (bounded by Nuclear envelope)	**Nucleus** Prokaryotic cells have no prominent nucleus. Chromosome consists of DNA only and it floats in cytoplasm near centre. This region is called nucleoid.
Organelles Membrane-bounded organelles like mitochondria, ER, Golgi appartatus are present	**Organelles** Membrane-bounded organelles like mitochondria, ER, Golgi appartatus are absent
Ribosomes Ribosomes are larger in size.	**Ribosomes** Ribosomes are smaller in size.
Size 10 times larger than prokaryotic cells	**Size** 10 times smaller than euokaryotic cells
Cell Wall Composition Cellulose in plants, Chitin in fungi	**Cell Wall Composition** Peptidoglycan (a large polymer of amino acids and sugars)

Q. No. 19 Describe relationship between cell function and cell structure.

RELATIONSHIP BETWEEN CELL FUNCTION & CELL STRUCTURE

The bodies of animals and plants are made up of different cell types. Each type performs specific function and all coordinated functions perform the life processes of organism.

Types of Cells:

Human body is made up of about 200 types of cells. Cells of one type may differ from those of other types in the following respects:

Size & Shape:

- Red blood cells are round to accommodate globular haemoglobin
- Nerve cells are long for the transmission of nerve-impulses.
- Xylem cells are tube-like & have thick walls for conduction of water & support.

Surface-Area to Volume Ratio:

- Root hair cells have large surface area for maximum absorption of water & salts.

Presence or absence of organelles:

- Cells involved in making secretions have more complex ER and Golgi apparatus.
- Cells involved in photosynthesis have chloroplasts.

Cell Specialization:

Individual cells contribute to the functioning of the whole body. It can be explained by the following examples of human body cells:

Nerve Cells:

Nerve cells conduct nerve conduct impulses & thus contribute to the coordination in body.

Muscle Cells:

Muscle cells undergo contraction and share their role in movements in body.

Red Blood Cells:

Red blood cells carry oxygen and so contribute in the role of blood in transportation.

White Blood Cells:

White blood cells kill foreign agents and so contribute in the role of blood in defence.

Skin Cells:

Some skin cells act as physical barriers against foreign materials and some act as receptors for temperature, touch and pain.

Bone Cells:

The cells of bone deposit calcium in their extracellular spaces to make the bone tough and thus contribute to the supporting role of bones.

Cells as an Open System:

A cell works as an 'open system', i.e. it takes in substances needed for its metabolic activities through its cell membrane. Then it performs the metabolic processes assigned to it. Products and by-products are formed in metabolism. Cell either utilizes the products or transports them to other cells. The by-products are either stored or are excreted out of the cell.

Q. No. 20 Write a note on cell size and surface area to volume ratio.

CELL SIZE AND SURFACE AREA TO VOLUME RATIO

Variation in Size:

Cells vary greatly in size. Most cells lie in between these extremes.

The Smallest Cell:

The smallest cells are bacteria called 'Mycoplasmas' with diameter between 0.1 μm to 1.0 μm.

The Bulkiest Cell:

The bulkiest cells are bird eggs.

The Longest Cell:

The longest cells are some muscle cells and nerve cells.

Relationship of Size and Shape to Function:

Cell size and shape are related to cell function.

Bird's Eggs:

Bird eggs are bulky because they contain a large amount of nutrients for the developing young.

Muscle Cells:

Long muscle cells are efficient in pulling different body parts together.

Nerve Cells:

Lengthy nerve cells can transmit messages between different body parts.

Red Blood Cells:

Human red blood cells are only 8 µm in diameter and therefore can move through out tiniest blood vessels, i.e. capillaries.

Surface Area of Cells:

Most cells are small in size. In relation to their volumes, large cells have less surface area as compared to small cells.

Example:

The figure shows 1 large cells and 27 small cells. The total volume is the same.

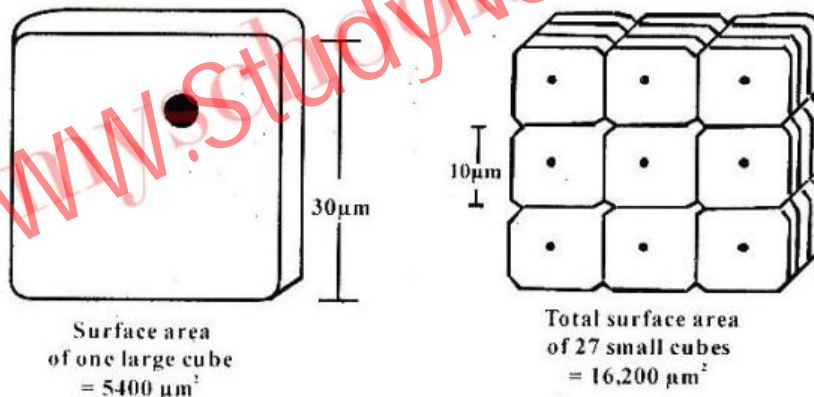



Figure: Effect of Cell Size on Surface Area

Calculation of Volume:

Volume = 30 µm x 30 µm x 30 µm = 27,000 μm^3

Calculation of Surface Area:

In contrast to the total volume, the total surface areas are very different. Because a cubical shape has 6 sides, its surface area is 6 times the area of 1 side. The surface area of cubes is as follows:

Surface Area of 1 large cube = 6 x (30 µm x 30 µm) = 5400 μm^2

Surface Area of 1 small cube = 6 x (10 µm x 10 µm) = 600 μm^2

Surface Area of 27 small cubes= 27 x 600 μm^2 = 16, 200 μm^2

Metabolic Activities and Cell Volume:

Need of nutrients and rate of waste production are directly proportional to cell volume. Cell takes up nutrients and excretes wastes through its surface cell membrane. So a large volume cell demands large surface area. But a large cell has a much smaller surface area relative to its volume than smaller cells have.

Conclusion:

The membranes of small cells can serve their volumes more easily than the membrane of a large cell.

Q. No. 21 Write a note on diffusion.

DIFFUSION

Definition

The movement of molecules from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient is called diffusion.

Explanation:

The molecules of any substance, (solid, liquid, or gas) are in motion when that substance is above 0 degree Kelvin or -273 degrees Centigrade. In a substance, majority of the molecules move from higher to lower concentration, although there are some that move from low to high.

Net Movement of Molecules:

The overall, or net movement is thus from high to low concentration.

Equilibrium State:

Eventually, the molecules reach a state of equilibrium where they are distributed equally throughout the area.

Passive Transport:

A cell does not expend energy when molecules diffuse across its membrane, the diffusion is type of passive transport.

Importance:

Diffusion is one principle method of movement of substances within cells, as well as across cell membrane. Carbon dioxide, oxygen, glucose, etc. can cross cell membranes by diffusion.

Examples:

- Gas exchange in gills and lungs occurs by diffusion.
- Movement of glucose molecules from the lumen into the blood capillaries of villi.

Q. No. 22 Write a note on facilitated diffusion.

FACILITATED DIFFUSION

Definition:

When a transport protein moves a substance from higher to lower concentration, the process is called facilitated diffusion.

Reason:

Many molecules do not diffuse freely across cell membranes because of their size or charge.

Transport Proteins:

Such molecules are taken into or out of cells with the help of transport proteins present in cell membranes.

Rate of Diffusion:

The rate of facilitated diffusion is higher than simple diffusion.

Passive Transport:

Facilitated diffusion is a type of passive transport because there is no expenditure of energy in this process.

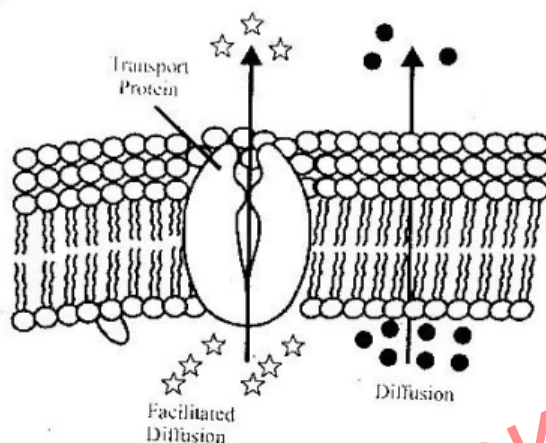



Figure: Diffusion and Facilitated Diffusion through Cell Membrane

Q. No. 23 Write a note on osmosis. Discuss water balance problems.

OSMOSIS

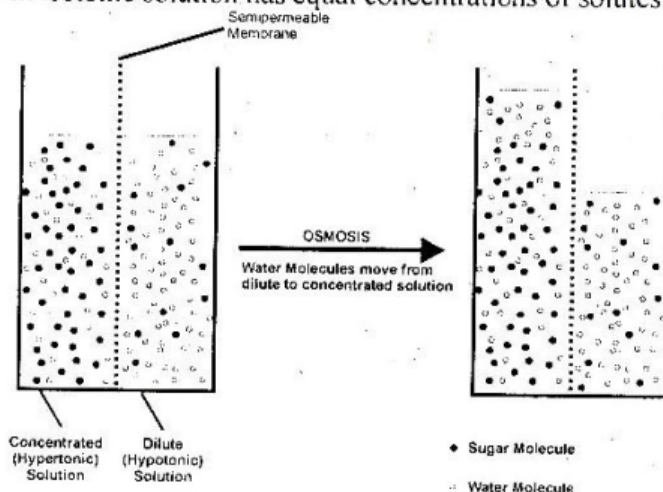
Definition: The movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration is called osmosis.

Tonicity of Solutions: The term tonicity refers to the relative concentration of solutes in the solutions being compared.

Types of Solutions: According to tonicity of solutions, the solutions can be categorized into three types:

Hypertonic Solution: A hypertonic solution has relatively more solute.

Hypotonic Solution: A hypotonic solution has relatively less solute.

Isotonic Solution: An isotonic solution has equal concentrations of solutes.

WATER BALANCE PROBLEMS

ANIMAL CELL:

Isotonic Solution:

When animal cell such as red blood cell, is placed in an isotonic solution, the cell volume remains constant because the rate at which water is entering the cell is equal to the rate at which it is moving out.

Hypotonic Solution:

When a cell is placed in a hypotonic solution, water enters and cell swells and may rupture like an over-filled balloon.

Hypertonic Solution:

When an animal cell is placed in a hypertonic solution it will lose water, and will shrink in size.

Results:

So in hypotonic environments (e.g. fresh water) animal cells must have ways to prevent excessive entry of water, and in hypertonic environments, (e.g. sea-water) they must have ways to prevent excessive loss of water.

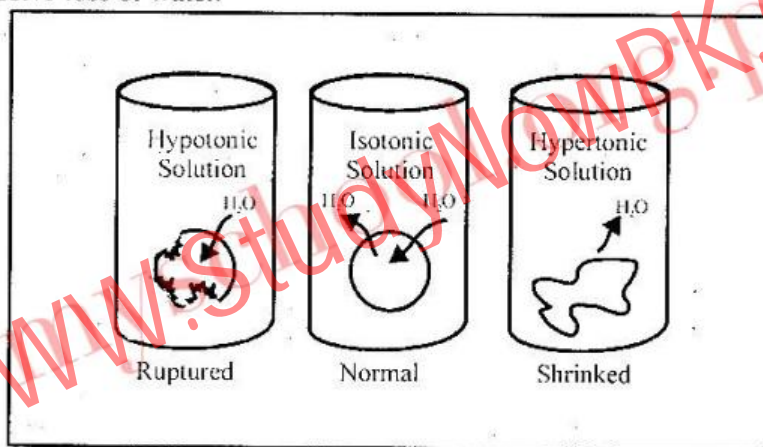



Figure: Effect of Tonicity on Animal Cell

PLANT CELLS:

Water-balance problems are somewhat different for plant cells because of their rigid cell walls.

Hypotonic Solution:

Most plant cells live in hypotonic environment, i.e. there is low concentration of solutes in extra-cellular fluids than in cells. As a result, water first tends to move first inside cell and then inside vacuole. When vacuole increases in size, cytoplasm presses firmly against the interior of cell wall, which expands a little. Due to the strong cell wall, plant cell wall does not rupture, but instead becomes rigid.

Turgor Pressure:

The outward pressure on the cell wall exerted by internal water is known as turgor pressure.

Turgor:

The phenomenon in which no more water can enter into the cell due to the development of turgor pressure is called turgor.

Turgid:

The cell in turgor state is called turgid.

Importance of Turgor:

The turgor of cells is responsible for maintaining shapes of non-woody plants and soft portions of trees and shrubs.

Isotonic Solution:

In isotonic environment, the net uptake of water is not enough to make the cell turgid, and it is flaccid (loose, not firm).

Hypertonic Solution:

In a hypertonic environment, a plant cell loses water and cytoplasm shrinks.

Plasmolysis:

The shrinking of cytoplasm is called plasmolysis.

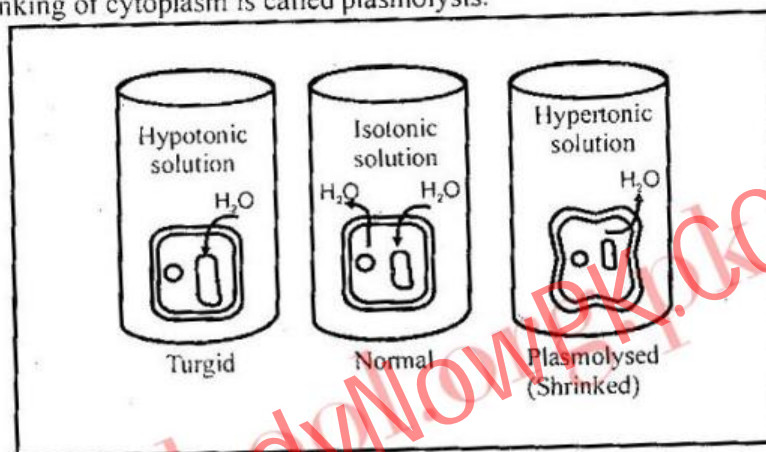



Figure: Effect of Tonicity on Plant Cell

Q. No. 24 Discuss the role of osmosis in turgidity of guard cells.

OSMOSIS AND GUARD CELLS

Guard Cells:

Stomata, the openings in leaf epidermis are surrounded by guard cells.

During Day Time/Opening of Stomata:

During day time, guard cells are making glucose, and so are hypertonic (have a higher concentration of glucose) than their nearby epidermal cells. Water enters them from other cells and they swell. Hence they assume a rigid bowed shape and a pore is created between them.

At Night Time/Closing of Stomata:

At night, there is low solute concentration in guard cells, water leaves them and they become flaccid. In this form, both guard cells rest against each other and the opening is closed.

Q. No. 25 Discuss the application of semi-permeable membrane.

APPLICATION OF SEMI-PERMEABLE MEMBRANES

The knowledge of semi-permeable membranes is applied for various purposes. Semi-permeable membrane is capable of separating substances.

Artificially synthesized semi-permeable membranes are used:

Separation of Bacteria from Viruses:

Semi-permeable membranes are used for the separation of bacteria from viruses, because bacteria cannot cross a semi-permeable membrane.

Advanced Water Treatment Technologies:

In advanced water treatment technologies, membrane based filtration systems are used. In this process, semi-permeable membranes separate salts from water (reverse osmosis).

Q. No. 26 Write a note on filtration.

FILTRATION

Definition:

A process by which small molecules are forced to move across semi-permeable membrane with the aid of hydrostatic (water) pressure, or blood pressure is called filtration.

Example:

In the body of an animal, blood pressure forces water and dissolved molecules to move through the semi-permeable membranes of the capillary wall cells.

Fate of Large Molecules:

In filtration, the pressure cannot force large molecules, such as proteins, to pass through the membrane pores.

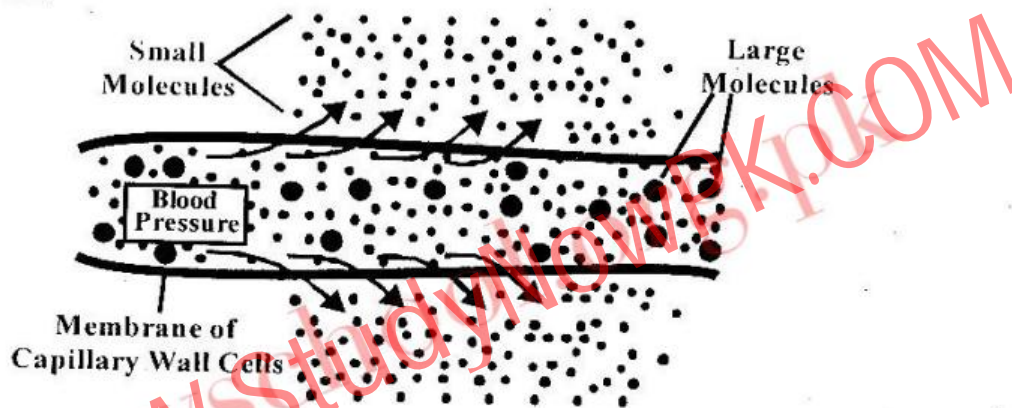



Figure: Filtration through the Cell Membrane of Capillary Wa

Q. No. 27 Write a note on active transport.

ACTIVE TRANSPORT

Definition:

The movement of molecules from an area of lower concentration to the area of higher concentration, with the expenditure of energy in the form of ATP is called active transport.

Concentration Gradient:

In active transport the movement is against the concentration gradient.

Utilization of Energy:

In this process, carrier proteins of cell membrane use energy to move the molecules against the concentration gradient.

Sodium-Potassium Pump:

The membranes of nerve-cells have carrier proteins in the form of sodium-potassium pump. In a resting (not conducting nerve impulse) nerve cell, this pump spends energy (ATP) to maintain a higher concentrations of K^+ and lower concentrations of Na^+ inside the cell. For this purpose, the pump actively moves Na^+ to the outside of the cell where they are already in the higher concentration. Similarly it moves K^+ from outside to inside where they are in higher concentration.

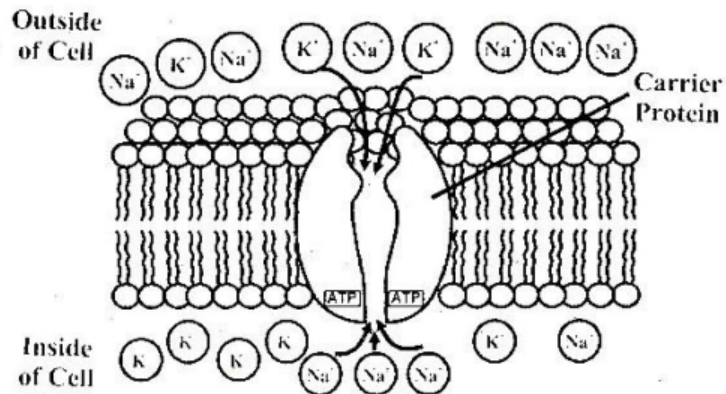



Figure: Sodium-Potassium Pump, Showing Active Transport

Q. No. 28 Write a note on endocytosis and exocytosis.

ENDOCYTOSIS

Definition:

The process of cellular ingestion of bulky materials by the infolding of cell-membrane is called endocytosis.

Types of Endocytosis:

There are two forms of endocytosis:

i. **Phagocytosis:** Cellular eating. Cell takes in solid materials.

ii. **Pinocytosis** : Cellular drinking. Cell takes in liquid in the form of droplets.

EXOCYTOSIS

Definition:

The process through which bulky material is exported outside the cell is called exocytosis.

Significance:

This process adds new membrane which replaces the part of cell membrane lost during endocytosis.

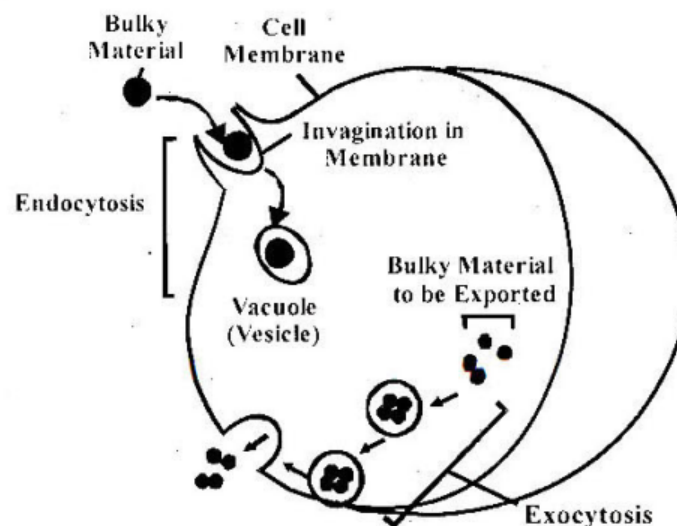



Figure: Endocytosis and Exocytosis

Q. No. 29 **Write a note on animal tissues.**

ANIMAL TISSUES

In the bodies of animals, there are four major categories of tissues:

i. Epithelial tissue
ii. Connective tissue
iii. Muscle tissue
iv. Nervous tissue

i. EPITHELIAL TISSUE

Location:

Epithelial tissue covers the outside of the body and lines organs and cavities.

Closely Packed Cells;

The cells in this tissue are very closely packed together.

Types:

The epithelial tissue has many types on the basis of shape of cells as well as the number of cell layers. Some types include:

- **Squamous Epithelium:**
  Squamous epithelium consists of a single layer of flat cells.
  Location:
  It is found in lungs, heart and blood vessels.
  Function:
  It allows the movement of materials across it.
- **Cuboidal Epithelium:**
  Cuboidal epithelium consists of a single layer of cube-shaped cells.
  Location:
  It is found in kidney tubes & small glands.
  Function:
  It makes secretions.
- **Columnar Epithelium:**
  Columnar epithelium has elongated cells.
  Location: It is found in alimentary canal, gall-bladder.
  Function: It makes secretions.
- **Ciliated Columnar Epithelium:**
  Ciliated columnar epithelium has elongated cells with cilia.
  Location:
  It is present in trachea & bronchi.
  Function:
  It propels mucous.
- **Stratified Squamous Epithelium:**
  Stratified Squamous Epithelium has many layers of flat cells.
  Location:
  It is present in the lining of oesophagus and mouth and also covers the skin.
  Function:
  It protects inner parts.

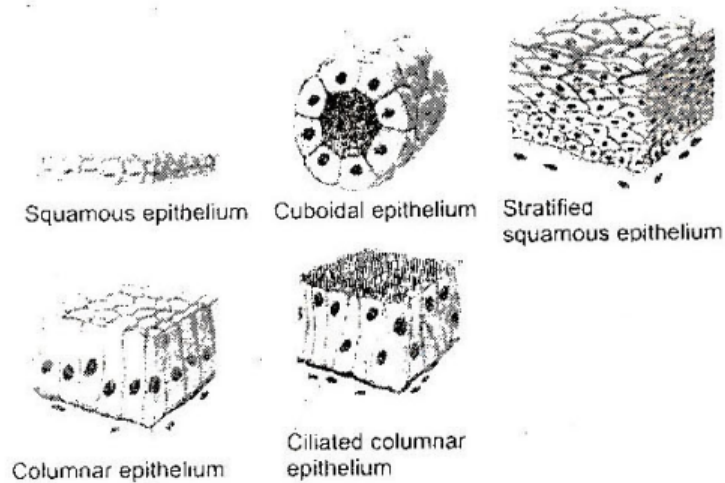



Figure: Epithelial Tissues in Animals

ii. CONNECTIVE TISSUE

Structure:

The connective tissue has cells scattered throughout an extracellular matrix.

Function:

- The connective tissue serves a 'connecting' function.
- It supports and binds other tissues.

Examples:

Common examples of connective tissue are:

Cartilage: Found around the ends of bones, in external ear, nose, trachea

Bone

Blood

Adipose Tissue: Found around kidneys, under skin, in abdomen

Adipose tissue provides energy and supports organs.

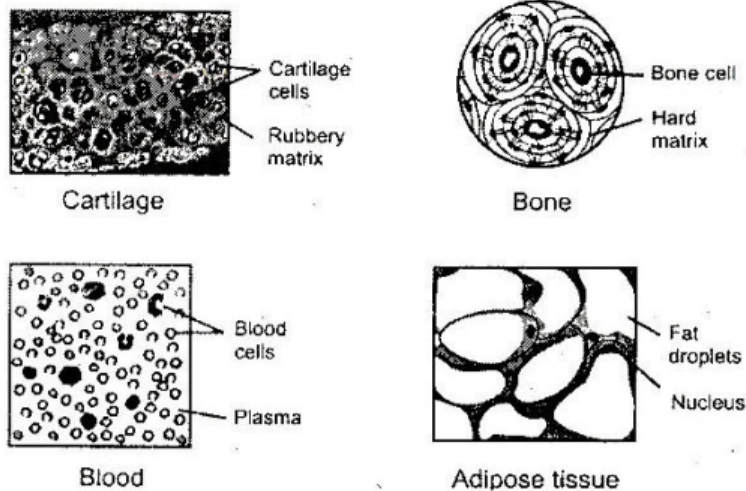



Figure: Connective Tissues in Animals

iii. MUSCLE TISSUE

Introduction:

Muscle tissue is the most abundant tissue in an animal.

Composition:

Muscle tissue consists of bundles of long cells called 'muscle fibers'.

Function:

They have the ability to contract.

Kinds of Muscle Tissues:

There are three kinds of muscle tissue:

- Skeletal muscles (Striated/striped)
- Smooth muscles
- Cardiac muscles

Skeletal Muscles:

Skeletal muscles or striated muscles are attached to bones.

Structure: The cells are striated (striped) and contain many nuclei.

Function: They are responsible for the movements of bones

Smooth Muscles: Smooth muscles are found in the walls of:

- Alimentary canal
- Urinary bladder
- Blood vessels

Structure: They contain smooth (non-striated) cells, each with a single nucleus.

Function: They are responsible for the movement of substances.

Cardiac Muscles:

Cardiac muscles are present in the wall of heart.

Structure: Their cells are striated but with a single nucleus in each cell.

Function: They produce heartbeat.

Difference between Skeletal and Smooth & Cardiac Muscles:

Skeletal muscles are voluntary in action. i.e. their contraction is under the control of our will.

Smooth & cardiac muscles are involuntary in action. i.e. their contraction is not under the control of our will.

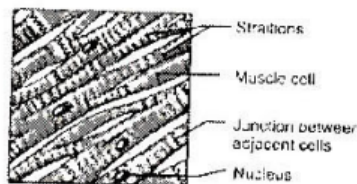



Figure: Types of Muscle Tissue

iv. NERVOUS TISSUE

An animal's survival depends on its ability to respond approximately to the stimuli from the environment. This ability requires the transmission of information among body parts. Nervous tissue forms a communicating system and performs this task.

Composition:

The nervous tissue is mainly composed of nerve cells or neurons.

Function:

The nerve tissue is specialized to conduct messages in the form of nerve impulses.

Location:

Nervous tissue is found in:

- Brain
- Spinal cord
- Nerves

Figure: Nervous Tissue

Epithelial tissue
Nervous tissue
Muscle tissue (skeletal)
Bone
Cartilage
Blood

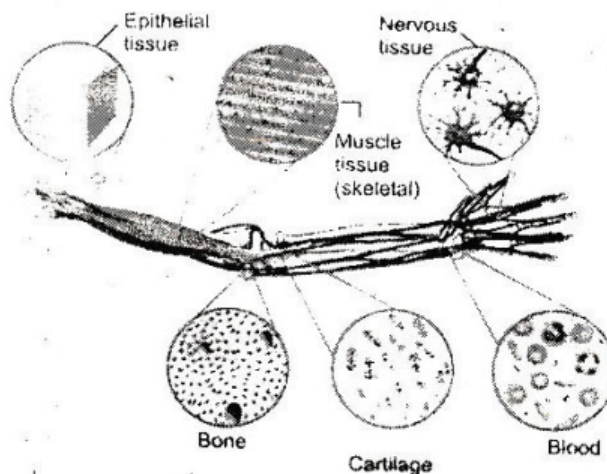



Figure: Different Tissues in Human Body

Q. No. 30 Write a note on plant tissues.

PLANT TISSUES

The cells of plants are grouped into tissues with characteristic functions such as photosynthesis, transport etc.

MAJOR TYPES OF PLANT TISSUES

There are two major categories of tissues in plants:

i. Simple tissues
ii. Compound (Complex) tissues

SIMPLE TISSUES

The tissues which are made up of a single type of cells are called simple tissues.

Types of Simple Tissues

They are of two types:

- Meristematic tissues
- Permanent tissues

MERISTEMATIC TISSUES

Characteristics:

- These tissues are composed of cells, which have the ability to divide.
- The cells are thin-walled.
- These cells have large nucleus.
- They have small or no vacuoles.
- There do not have inter-cellular spaces among them.

Types of Meristematic Tissues:

There are two main types of meristematic tissues:

i. Apical Meristems:

Location:

Apical meristems are located at the apices (tips) of roots and shoot.

Function:

When they divide, they cause increase in the length of plant. Such growth is called primary growth.

ii. Lateral Meristems:

Location:

Lateral meristems are located on the lateral sides of roots and shoot.

Function:

When they divide, they are responsible for increase in the girth of plant. Such growth is called secondary growth.

Types: They are of further two types:

- Vascular Cambium (located between xylem and phloem)
- Cork Cambium (in the outer lateral sides of plant).

Intercalary Meristem:

Intercalary meristem is in the form of small patches among mature tissues. These are common in grasses and help in the regeneration of parts removed by herbivores.

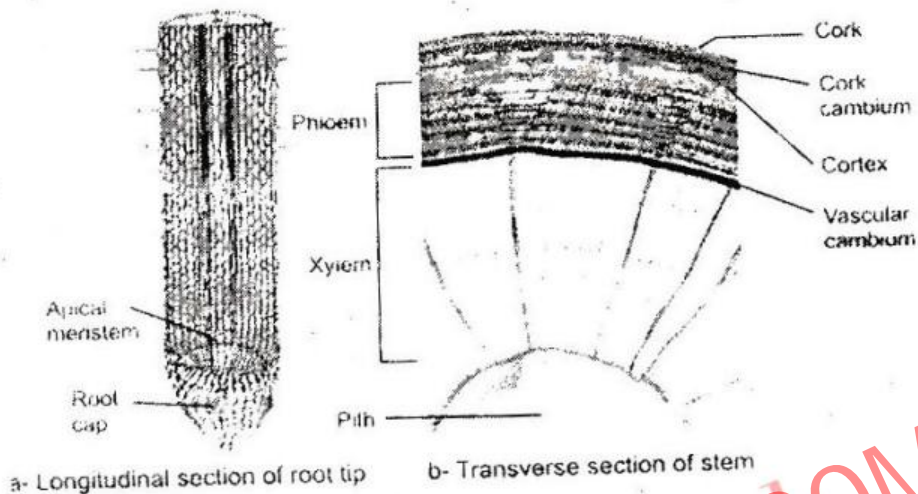



Figure: (a) Apical Meristem at root tip and
(b) Vascular and Cork Cambium in stem

PERMANENT TISSUES

Definition:

The cells of the tissues which do not have the ability to divide are called permanent tissues.

Origin:

Permanent tissues originate from meristematic tissues.

Types:

Permanent tissues are classified into the following types:

i. Epidermal Tissues
ii. Ground Tissues
iii. Support Tissues

i. Epidermal Tissues:

Introduction:

Epidermal tissues are a kind of permanent tissues. They do not have the ability to divide.

Composition:

Epidermal tissues are composed of a single layer of cells.

Location:

They cover the plant body.

Functions

- They act as barrier between environment and internal plant tissues.
- In roots, they are responsible for the absorption of water and minerals.
- On stem and leaves, they also secrete cutin (the coating of cutin is called cuticle) which prevents evaporation.
- Specialized structures are also present which perform specific functions, e.g. root hair and stomata.

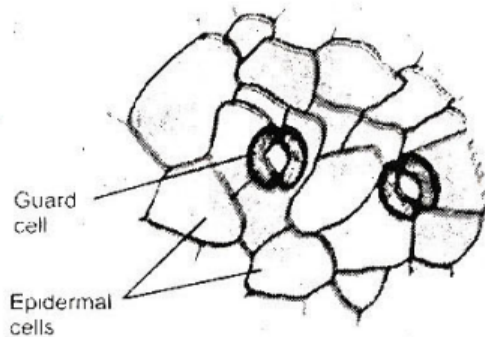



Figure: Epidermal Tissue

ii. Ground tissues:

Introduction:

Ground tissues are a kind of permanent tissues. Ground tissue is the most abundant tissue in plants.

Characteristics:

- These tissues are made up of parenchyma cells.
- They are spherical but flat at the point of contact.
- They have thin primary cell walls.
- They have large vacuoles for the storage of food.

Functions

- In leaves, they are called mesophyll and are the sites of photosynthesis.
- In other parts, they are sites of respiration and protein synthesis.
- They also store food in their vacuoles.

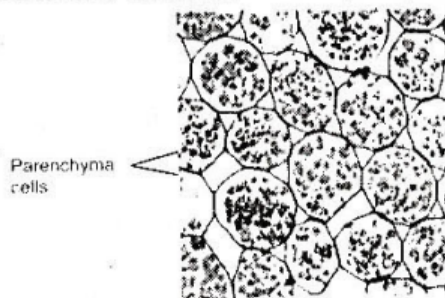



Figure: Ground Tissue

iii. Support Tissues:

The tissues that provide strength and flexibility to plants are called support tissues.

Types:

i. Collenchyma Tissue:

Structure: They are made up of elongated cells with unevenly thickened primary cell walls.

Location: They are found in:

- Cortex (beneath epidermis) of young stems,
- Mid-ribs of leaves
- Petals of flowers

Function: They are flexible and function to support the organs where they are found.

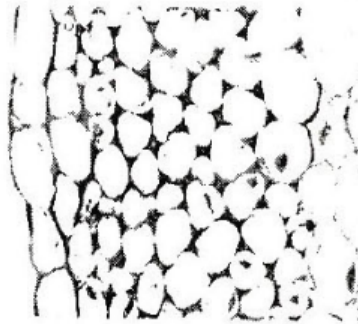



Figure: Sclerenchyma Tissue

ii. Sclerenchyma Tissue:

Composition:

They are composed of cells with rigid secondary cell walls. The cell walls are hardened with lignin, which is the main chemical component of wood.

Mature Cells:

Mature cells cannot elongate and most of them are dead.

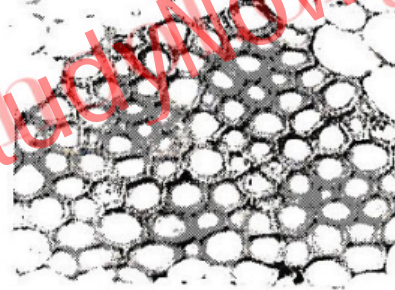



Figure: Sclerenchyma Tissue

COMPOUND/COMPLEX TISSUES

Definition:

A plant tissue composed of more than one type of cell is called a compound or complex tissue.

Occurrence:

They are found only in vascular plants.

Examples:

- Xylem
- Phloem

Xylem Tissue:

Composition:

- Due to the presence of lignin, the secondary walls of its cells are thick and rigid.

Types:

Two types of cells are found in xylem tissue: Vessel elements or cells & Tracheids.

Vessel Elements: They have thick secondary cell walls. They lack end walls and join together to make tubes.

Tracheids: They are slender cells with overlapping ends.

Functions:

- Xylem tissue is responsible for the transport of water & dissolved substances from roots to the aerial parts.
- It also provides support to the plant body due to the presence of lignin.

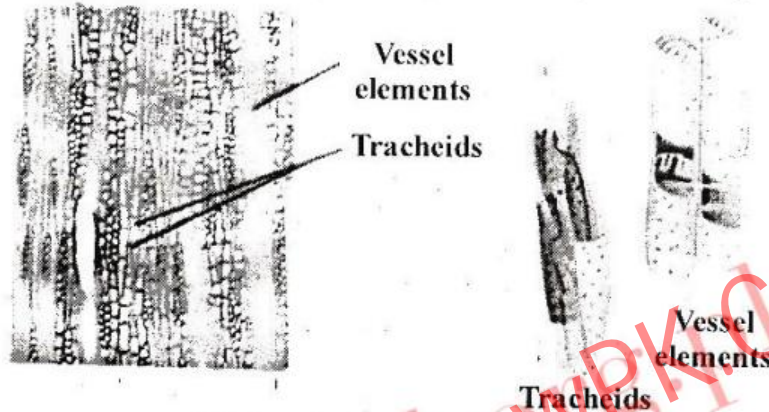



Figure: Xylem Tissue

Phloem Tissue:

Composition:

Phloem tissue contains: Sieve tube cells & companion cells.

Sieve Tube Cells: They are long, and their end walls have small pores. Many sieve tube cells join to form long sieve tubes.

Companion Cells: They make proteins for sieve tube cells.

Function:

Phloem tissue is responsible for the conduction of dissolved organic matter (food) between different parts of plant body.

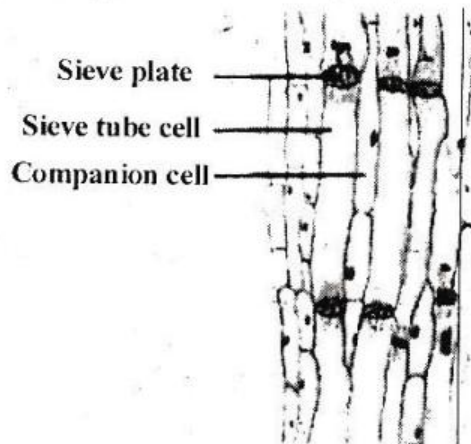



Figure: Phloem Tissue

REVIEW QUESTIONS

MULTIPLE CHOICE QUESTIONS

1. **Which of these clues would tell you whether a cell is prokaryotic or eukaryotic?**
   (a) The presence or absence of a cell wall
   (b) Whether or not the cell is partitioned by internal membranes
   (c) The presence of absence of ribosomes
   (d) Whether or not the cell contains DNA
2. **There are ____ micrometers (μm) in one millimeter (mm).**
   (a) 10 (b) 100
   (c) 1000 (d) 1/1000
3. **The plasma membrane does all of these except:**
   (a) Contains the hereditary material
   (b) Acts as a boundary or border for they cytoplasm
   (c) Regulates passage of materials in and out of cell
   (d) Functions in the recognition of cell
4. **Which of these materials is not a component of plasma membrane?**
   (a) Lipids (b) Carbohydrates
   (c) Proteins (d) DNA
5. **Cell walls are found in these organisms except for:**
   (a) Plants (b) Animals
   (c) Bacteria (d) Fungi
6. **The ____ is a major component of plant cell walls.**
   (a) Chitin (b) Peptidoglycan
   (c) Cellulose (d) Cholesterol
7. **Plant cells have ________ and ______ , which are not present in animal cells.**
   (a) Mitochondria, chloroplasts (b) Cell membranes, cell walls
   (c) Chloroplasts, nucleus (d) Chloroplasts, cell wall
8. **The _____ is the membrane-enclosed structure in eukaryotic cells that contain the DNA of the cell.**
   (a) Mitochondrion (b) Chloroplast
   (c) Nucleolus (d) Nucleus
9. **Ribosomes are constructed in the:**
   (a) Endoplasmic reticulum (b) Nucleoid
   (c) Nucleolus (d) Nuclear pore
10. **Rough endoplasmic reticulum is the area in the cell where ________ are synthesized.**
    (a) Polysaccharides (b) Proteins
    (c) Lipids (d) DNA
11. **Smooth endoplasmic reticulum is the area in a cell where ________ are synthesized.**
    (a) Polysaccharides (b) Proteins
    (c) Lipids (d) DNA

12. **The mitochondrion functions in:**
    (a) Lipid storage (b) Protein synthesis
    (c) Photosynthesis (d) Cellular respiration
13. **The thin extensions of the inner mitochondrial membrane are known as:**
    (a) Cristae (b) Matrix
    (c) Thylakoids (d) Stroma
14. **The chloroplast functions in:**
    (a) ATP synthesis (b) Protein synthesis
    (c) Photosynthesis (d) DNA replication
15. **Which of these cellular organelles have their own DNA?**
    (a) Chloroplast (b) Nucleus
    (c) Mitochondrion (d) All of these

ANSWERS:

1	b	2	c	3	a	4	d	5	b
6	c	7	d	8	d	9	c	10	b
11	c	12	d	13	a	14	c	15	d

UNDERSTANDING THE CONCEPTS

(1) **Explain the functions of Cell Membrane.**
Consult Long Question No. 6

(2) **Describe the structure of Cell Wall.**
Consult Long Question No. 5

(3) **Discuss nucleus structure and function.**
Consult Long Question No. 9

(4) **Describe the structure and function of Endoplasmic Reticulum and Golgi Apparatus.**
Consult Long Questions No. 12 & 13

(5) **Describe the formation and function of Lysosomes.**
Consult Long Question No. 15

(6) **Explain what would happen when a plant and animal cell is placed in a hypertonic solution.**
Consult Long Question No. 23

(7) **Describe the internal structure of a Chloroplast and compare it with that of a Mitochondrion.**
Consult Long Question No. 12 for internal structure of chloroplast.

STRUCTURAL COMPARISON

Similarities:

- Both are double-membranous organelles.
- Both have smooth outer membranes.
- Both have folded inner membranes.

- Both have an internal matrix
- Both have their own DNA and ribosomes
- Both are major energy centers, chloroplasts in plants and mitochondria in animals

Differences:

- Chloroplasts have photosynthetic pigments while mitochondria are not.
- The inner membrane of mitochondria does not form stacks like thylakoids in chloroplasts it forms cristae.
- Mitochondria are sites of aerobic respiration while chloroplasts are sites of photosynthesis.

(8) Explain the phenomena involved in the passage of matter across cell-membrane.

SEMI-PERMEABILITY OF CELL MEMBRANE

Cell membranes act as barriers to most but not all molecules. That is why cell membranes are called semi-permeable membranes. They maintain equilibrium inside cell as well as outside by exchanging matter with cell's environment according to needs. Cell membranes do it through the phenomena of:

- Diffusion
- Facilitated diffusion
- Osmosis
- Filtration
- Active transport
- Endocytosis
- Exocytosis

For details Consult Long Questions No. 21, 22, 23, 26, 27 & 28

(9) Describe how turgor pressure develops in a plant cell.

DEVELOPMENT OF TURGOR PRESSURE IN PLANT CELL

Turgor Pressure:

The outward pressure on the cell wall exerted by internal water is known as turgor pressure.

Mechanism:

Type of Environment:

Most plant cells live in hypotonic environment, i.e. there is low concentration of solutes in extra-cellular fluids than in cells.

Movement of Water:

As a result, water first tends to move inside the cell and then inside the vacuole.

Pressure of Cytoplasm:

When a vacuole increases in size, cytoplasm presses firmly against the interior of cell wall, which expands a little.

Firmness of the Cell

Due to the strong cell wall, the cell does not rupture, but instead becomes rigid.

(10) State the relationship between cell structure and cell function.

Consult Long Question No. 19

(11) Describe the differences in prokaryotic and eukaryotic cells.

Consult Long Question No. 18

(12) Explain how surface-area to volume ratio limits cell size.

Consult Long Question No. 20

(13) **Describe the major animal tissues in terms of their cell specificities, locations, and functions.**

Consult Long Question No. 29

(14) **Describe the major plant tissues in terms of their cell specificities, locations, and functions.**

Consult Long Question No. 30

SHORT QUESTIONS

(1) **State the Cell Theory.**

Consult Short Question No. 10

(2) **What are the functions of Chromoplasts and Leucoplasts?**

Consult Long Question No. 12

(3) **Differentiate between diffusion and facilitated diffusion.**

Feature	Diffusion	Facilitated Diffusion
Definition	Diffusion is the movement of molecules from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient.	Facilitated diffusion is a type of diffusion across cell membrane in which transport-proteins are used to transport the substance from higher to lower concentration.
Size & Charge	Size and charge are not significant in simple diffusion.	Size and charge are important factors in facilitated diffusion.
Carrier Proteins	No carrier proteins are required.	Carrier proteins are required.
Rate	Slower rate of diffusion	Rapid rate of diffusion
Examples		
	Gaseous exchange in gills	Movement of ions across cell membrane
	Movement of glucose from small intestine lumen into capillaries	Movement of several water-soluble molecules across cell membrane.

(4) **What is meant by hypertonic and hypotonic solutions?**

Consult Long Question No. 23

THE TERMS TO KNOW

Active transport: Active transport is the movement of molecules from an area of lower concentration to higher concentration, (against the concentration gradient), with the expenditure of energy in the form of ATP

Cell: The structural, functional, and biological unit of all living organisms

Cell membrane: Thin elastic and semi permeable covering of all cells

Cell theory: A set of postulates stating

- All organisms are composed of one or more cells.
- Cells are the smallest living things, the basic unit of organization of all organisms.
- Cells arise only by divisions in previously existing cells.

Cell wall: A rigid, non-living strong covering of cell which provides shape and protection

Centriole: Cylindrical structure composed of groupings of microtubules arranged in a 9 + 3 pattern.
Chloroplast: A type of plastid/chlorophyll-containing organelle in plants which carries out photosynthesis
Chromoplast: A type of plastid which gives peculiar colors to petals and fruits
Connective tissue: A type of animal tissue which exists throughout the body and serves a connecting function e.g. blood
Cytoplasm: The semi-viscous and semi-transparent substance between plasma membrane (cell membrane) and the nuclear envelope
Diffusion: The movement of molecules from an area of higher concentration to the area of lower concentration i.e. along the concentration gradient
Endoplasmic reticulum: A network of inter-connected channels that extends from cell membrane to nuclear envelope.
Epithelial tissue: Cellular membranous tissue consisting of closely packed cells covering external surface. internal organs and other internal surfaces of the body
Facilitated diffusion: A type of diffusion across cell membrane in which transport-proteins are used to transport the substance from higher to lower concentration.
Golgi apparatus: A network of stacked membranous vesicles present in most living cells that functions in the formation of secretions within the cell.
Hypertonic solution: A solution which has relatively more solute
Hypotonic solution: A solution which has relatively less solute
Isotonic solution: A solution with the same concentration of solute
Leucoplast: A type of colorless plastid involved in food storage
Lysosome: A single membranous organelle which contains strong digestive enzymes
Mitochondrion: A double membranous organelle found in eukaryotic cells concerned with aerobic respiration and energy production
Muscle tissue: A type of animal tissue with the ability to contract. consisting of long muscle fibers
Nucleus: A membrane bound structure that contains the cell's hereditary information and controls the cell's growth and reproduction.
Organelle: Membrane-bound compartment or structure of a cell which perform specialized function
Osmosis: The movement of water across a semi-permeable membrane from a solution of lesser solute concentration to a solution of higher solute concentration.
Passive transport: A kind of transport by which ions or molecules move along a concentration gradient, which means movement from an area of *higher* concentration to an area of *lower* concentration. Without the expenditure of energy
Phagocytosis: The process by which a cell engulfs or ingests a particle. Cellular eating.
Pinocytosis: The process by which a cell takes in liquid droplets. Cellular drinking
Plasmolysis: Shrinkage or contraction of cytoplasm due to loss of water when placed in a hypertonic solution
Plastid: A type of plant organelle which is double membranous. involved in synthesis and storage of food
Ribosome: A tiny granular structure involved in protein synthesis within a cell
Semi-permeable: Allowing only some materials to pass through
Tissue: An aggregation of similar cells performing a similar function
Turgor pressure: The pressure exerted by the cytoplasm against cell wall when water enters the cell from a hypotonic environment.